Post 1 of 10

DOLPHIN GREEN CAR WASH

POST DEVELOPMENT 10-YEAR STORM

System A

1. Node A01 → A02

Same as predevelopment condition

$Q_{A02} = 0.041$ cfs $A = 0.034$

$T_c = 8.7$ min $\Sigma CA = 0.012$

$I = 3.4$ in/hr

2. Node A02 → A03

Same as pre development condition

$Q_{A03} = 0.1$ cfs $A = 0.062$ ac

$T_c = 10.2$ min $\Sigma CA = 0.034$

$I = 3.0$ in/hr

3. Node A03 → A04 (outlet 1)

$C = 0.35$ $L = 40'$

$A = 0.017$ ac $S = 0.066$

$CA = 0.006$

$\Sigma CA = 0.034 + 0.006 = 0.04$ Vditch

Post 10-2/10

Assume $q_{ave} = 1.0$ cfs/ac , $V = 2$ ft/s

$Q_{ave} = Q_{A03} + (1.0)(0.017)/2$

$= 0.1 + .009 = .11$

$= 0.11$ cfs

$T_t = \frac{L/V}{60} = \frac{40/2}{60} = 0.33$ min

$T_c = 10.2 + 0.33$
$= 10.5$ min
$I = 2.9$ in/hr

$Q_{A04} = \Sigma CA I = (0.04)(2.9) = \underline{0.12 \text{ cfs}}$

check
↳ $Q_{ave} = 0.1 + (.12 - .1)/2 = 0.11 \approx 0.11$ ✓

Outlet 1 @ SD on El Camino Real:

$Q_A = 0.11$ cfs	$\Sigma CA = 0.04$
$T_c = 10.5$ min	Area $A = 0.11$ ac
$I = 2.9$ in/hr	

System B

1. Node B01 → B03 (Gen. Comm)

C = 0.82 L = 330' T_c = 2.9 min
A = 0.41 ac S = 0.06 I = 4.75 in/hr
ΣCA = 0.34 Lm = 90'

$$Q_{B03} = \Sigma CA\, I = (0.34)(4.75) = 1.62 \text{ cfs}$$

$Q_{B01 \rightarrow B03}$ = 1.62 cfs	ΣCA = 0.34
T_c = 2.9 min	A = 0.41
I = 4.75 in/hr	

2. Node B02 → B03 (Gen. Comm)

C = 0.82 L = 216' T_c = 3.2 min
A = 0.19 ac S = 0.037 I = 4.75 in/hr
ΣCA = 0.16 Lm = 90'

$$Q_{B02 \rightarrow B03} = \Sigma CA\, I = (0.16)(4.75) = 0.76 \text{ cfs}$$

$Q_{B02 \rightarrow B03}$ = 0.76 cfs	ΣCA = 0.16
T_c = 3.2 min	A = 0.19 ac
I = 4.75 in/hr	

POST 10-4/10

3. Junction of System B at B03

	System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ΣCA
Y	B01 → B03	1.62	2.9	4.75	0.41	0.34
→ Z	B02 → B03	0.76	3.2	4.75	0.19	0.16

$0 < T_{cY} < T_{cZ} \rightarrow 0 < 2.9 < 3.2$

$$Q_{TY} = Q_Y + \frac{T_Y}{T_Z} Q_Z = 1.62 + \frac{2.9}{3.2}(0.76) = 2.31 \text{ cfs}$$

$$Q_{TZ} = Q_Z + \frac{I_Z}{I_Y} Q_Y = 0.76 + \frac{4.75}{4.75}(1.62) = \underline{\underline{2.38}} \text{ cfs}$$

System B total at B03 (driveway trench drain)

$Q_{B03} = 2.38$ cfs

$T_c = 3.2$ min

$I = 4.75$ in/hr

$A = 0.60$ ac

$\Sigma CA = 0.50$

POST 10-5/10

System C

1. Node C01 → C02 (natural, Landscape)

$C = 0.35$ $L = 116'$ $T_c = 12.5$ min

$A = 0.03$ ac $S = 0.013$ $I = 2.6$ in/hr

$\Sigma CA = 0.011$ $L_m = 70'$

$$Q_{C01 \to C02} = \Sigma CA\, I = (0.011)(2.6) = 0.03 \text{ cfs}$$

$Q_{C02} = 0.03$ cfs	$\Sigma CA = 0.011$
$T_c = 12.5$ min	$A = 0.03$ ac
$I = 2.6$ in/hr	

2. Node C03 → C04 (street flow)

$C = 0.85$ $L = 162'$

$A = 0.13$ ac $S = .046$

$CA = 0.11$ $n = 0.013$

$\Sigma CA = 0.011 + 0.11 = 0.12$

assume $q_{ave} = 2.0$ cfs/ac, $V = 2.5$ ft/s

$Q_{ave} = 0.03 + (2.0)(0.13)/2 = 0.16$ cfs

$T_t = \frac{L/V}{60} = \frac{(162/2.5)}{60} = 1.0$ min. $T_c = 12.5 + 1.0 = 13.5$ min

$I = 2.5$ in/hr

$Q_{C03-C04} = \Sigma CAI = (0.12)(2.5) = 0.30$ cfs

Check

$Q_{ave} = 0.03 + (.30 - .03)/2 = 0.17 \approx 0.16$ cfs ✓

$Q_{C03-C04} = 0.30$ cfs	$\Sigma CA = 0.12$
$T_c =$ 13.5 min	$A = 0.13$ ac
$I =$ 2.5 in/hr	

3. Node C05 → C04 (Natural, Landscape)

$C = 0.35$	$L = 150'$	$T_c = 6.9$ min
$A = 0.048$ ac	$S = 0.082$	
$\Sigma CA = 0.0168$	$L_m = 100'$	$I = 3.7$ in/hr

$Q_{C05 \to C04} = \Sigma CAI = (0.0168)(3.7) = 0.062$ cfs

$Q_{C05 \to C04} = 0.062$ cfs	$\Sigma CA = 0.0168$
$T_c = 6.9$ min	$A = 0.048$ ac
$I = 3.7$ in/hr	

7/10

4. Junction @ CO4 from CO3 & CO5

	System	Q(cfs)	Tc(min)	I(in/hr)	A(ac)	ΣCA
→ z	CO3 → CO4	0.30	13.5	2.5	0.13	0.12
y	CO5 → CO4	0.062	6.9	3.7	0.048	0.0168

$0 < T_{cy} < T_{cz} \rightarrow \quad 0 < 6.9 < 13.5$

$$Q_{Ty} = Q_y + \frac{T_y}{T_z} Q_z = 0.062 + \frac{6.9}{13.5}(.30) = 0.22 \text{ cfs}$$

$$Q_{Tz} = Q_z + \frac{I_z}{I_y} Q_y = 0.30 + \frac{2.5}{3.7}(0.062) = \underline{\underline{0.34}} \text{ cfs}$$

Junction CO4 =

$Q_{CO4} = 0.34$ cfs

$T_c = 13.5$ min

$I = 2.5$

$\Sigma CA = 0.14$

$A_{red\ total} = 0.21$ ac

post 10-8/10

5. Node C04 → C06 (Street flow)

C = 0.82
A = 0.17 ac
CA = 0.14
ΣCA = 0.14 + 0.14 = 0.28

L = 190'
S = 0.041
n = 0.013

Assume q_{ave} = 2.0 cfs/ac, v = 3.0 ft/s

$Q_{ave} = 0.34 + (2.0)(0.17)/2 = 0.51$ cfs ←

$T_t = \frac{L/v}{60} = \frac{190/3}{60} = 1.1$ min

$T_c = 13.5 + 1.1 = 14.6$ min

I = 2.4 in/hr

$Q_{C04 \rightarrow C06} = \Sigma CAI = (0.28)(2.4) = \underline{\underline{0.67}}$ cfs

check
↳ $Q_{ave} = 0.34 + (0.67 - 0.34)/2 = 0.51$ cfs ✓ ok

Q_{C06} = 0.67 cfs	ΣCA = 0.28
T_c = 14.6 min	
I = 2.4 in/hr	

Post to 9/10

System D

1. Node D01 → D02 (natural)

C = 0.35 L = 290' T_c = 8.7 min

A = 0.48 ac S = 0.037 I = 3.25 in/hr

ΣCA = 0.168 L_m = 100'

$$Q_{D01 \rightarrow D02} = \Sigma CAI = (0.168)(3.25) = 0.55 \text{ cfs}$$

Q_{D02} = 0.55 cfs	ΣCA = 0.168
T_c = 8.7 min	
I = 3.25 in/hr	

POST 10-10/10

2. Outlet 2 – Junction of C06 & D02 @ Storm Drain on Via Rosa

	System	Q(cfs)	Tc (min)	I(in/hr)	A(ac)	ΣCA
→ Z	C	0.67	14.5	2.4	0.38	0.28
Y	D	0.55	8.7	3.25	0.48	0.168

$0 < T_{cy} < T_{cz} \rightarrow 0 < 8.7 < 14.5$

$$Q_{Ty} = Q_y + \frac{T_y}{T_z} Q_z = 0.55 + \frac{8.7}{14.5}(0.67) = 0.95 \text{ cfs}$$

$$Q_{Tz} = Q_z + \frac{I_z}{I_y} Q_y = 0.67 + \frac{2.4}{3.25}(0.55) = \underline{1.08} \text{ cfs}$$

$Q_{outlet2} = 1.08$ cfs

$T_C = 14.5$ min — 10-Year

$I = 2.4$ in/hr — Post Development

$A = 0.86$ ac

Post 100-1/10

DOLPHIN GREEN CAR WASH

POST DEVELOPMENT 100-YEAR STORM

System A

1. Node A01 → A02

Same as predevelopment condition

$Q_{A02} = 0.06$ cfs $\Sigma CA = 0.012$

$T_c = 8.7$ min $A = 0.034$ ac

$I = 5$ in/hr

2. Node A02 → A03

Same as predevelopment condition

$Q_{A03} = 0.15$ cfs $\Sigma CA = 0.034$

$T_c = 10.2$ min $A_2 = 0.062$ ac

$I = 4.5$ in/hr

3. Node A03 → A04

$C = 0.35$ $L = 40'$

$A = 0.017$ ac $S = 0.066$

$CA = 0.006$

$\Sigma CA = 0.034 + .006 = 0.04$ V ditch

POST 100-2/10

Assume $q_{ave} = 2.0$ cfs/ac, $V = 2$ ft/s

$Q_{ave} = 0.15 + (2.0)(0.617)/2 = 0.17$ cfs

$T_t = \frac{L/V}{60} = \frac{40/2}{60} = 0.33$ min

$T_C = 10.2 + 0.33 = 10.5$ min

$I = 4.5$ in/hr

$Q_{A04} = \Sigma CAI = (0.04)(4.5) = 0.18$ cfs

check

$Q_{ave} = 0.15 + (.18 - .15)/2 = 0.17$ cfs = ✓ ok

Outlet 1 @ SD on El Camino Real:

$Q_A = 0.17$ cfs	$\Sigma CA = 0.04$
$T_C = 10.5$ min	$A = 0.11$ ac
$I = 4.5$ in/hr	

POST 100-3/10

System B

1. Node B01 → B03 (Gen. Comm)

C = 0.82
A = 0.41 ac
ΣCA = 0.34

L = 330'
S = 0.06
Lm = 90'

T_c = 2.9 min
I = 7.0 in/hr

$$Q_{B01 \to B03} = \Sigma CAI = (0.34)(7) = 2.38 \text{ cfs}$$

$Q_{B01 \to B03}$ = 2.38 cfs	ΣCA = 0.34
T_c = 2.9 min	A = 0.41 ac
I = 7.0 in/hr	

2. Node B02 → B03 (Gen. Comm)

C = 0.82
A = 0.19 ac
ΣCA = 0.16

L = 216'
S = 0.037
Lm = 90'

T_c = 3.2 min
I = 7.0 in/hr

$$Q_{B02 \to B03} = \Sigma CAI = (0.16)(7) = 1.12 \text{ cfs}$$

$Q_{B02 \to B03}$ = 1.12 cfs	ΣCA = 0.16
T_c = 3.2 min	A = 0.19 ac
I = 7. in/hr	

P051100-4/10

3. Junction of System B at B03

	System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ECA
Y	B01→B03	2.38	2.9	7.0	0.41	0.34
→ Z	B02→B03	1.12	3.2	7.0	0.19	0.16

$0 < T_{cY} < T_{cZ} \rightarrow 0 < 2.9 < 3.2$

$$Q_{TY} = Q_Y + \frac{T_Y}{T_Z} Q_Z = 2.38 + \frac{2.9}{3.2}(1.12) = 3.32 \text{ cfs}$$

$$Q_{TZ} = Q_Z + \frac{I_Z}{I_Y} Q_Y = 1.12 + \frac{7.0}{7.0}(2.38) = \underline{3.50 \text{ cfs}}$$

System B total @ B03 (driveway trench drain)

$Q_{B03} = 3.50$ cfs

$T_C = 3.2$ min

$I = 7$ in/hr

$A = 0.60$ ac

$ECA = 0.50$

POST 100-5/10

System C

1. Node C01 → C02 (natural, Landscape)

C = 0.35 | L = 116' | T_c = 12.5 min
A = 0.03 ac | S = 0.013
ΣCA = 0.011 | L_m = 70' | I = 4 in/hr

$Q_{C01 \rightarrow C02} = \Sigma CAI = (0.011)(4) = 0.044$ cfs

$Q_{C02} = 0.04$ cfs | ΣCA = 0.011
T_c = 12.5 min | A = 0.03 ac
I = 4 in/hr

2. Node C03 → C04 (Street Flow)

C = 0.85 | L = 162'
A = 0.13 ac | S = 0.046
CA = 0.11 | n = 0.013
ΣCA = 0.011 + 0.11 = 0.12

Assume q_{ave} = 3.4 cfs/ac , V = 2.5 ft/s

$Q_{ave} = 0.04 + (3.4)(0.13)/2 = 0.26$ cfs

$T_t = \frac{L/V}{60} = \frac{162/25}{60} = 1.0$ min | $T_c = 12.5 + 1.0 = 13.5$ min
I = 3.9 in/hr

POST 100-6/10

$Q_{C03 \to C04} = \Sigma CAI = (0.12)(3.9) = \underline{0.47 \text{ cfs}}$

check

$Q_{ave} = 0.04 + (.47 - 0.04)/2 = 0.26 \text{ cfs} = 0.26$ ✓ok

$Q_{C03 \to C04} = 0.47$ cfs	$\Sigma CA = 0.12$
$T_c = 13.5$ min	$A = 0.13$ ac
$I = 3.9$ in/hr	

3, Node C05 → C04 (Natural Landscape)

$C = 0.35$
$A = 0.048$ ac
$\Sigma CA = 0.0168$

$L = 150'$
$S = 0.082$
$L_m = 100'$

$T_c = 6.9$ min
$I = 5.5$ in/hr

$Q_{C05 \to C04} = \Sigma CAI = (0.0168)(5.5) = 0.09$ cfs

$Q_{C05 \to C04} = 0.09$ cfs	$\Sigma CA = 0.0168$
$T_c = 6.9$ min	$A = 0.048$ ac
$I = 5.5$ in/hr	

4. Junction @ C04 from C03 & C05

	System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ECA
→ z	C03 → C04	0.47	13.5	3.9	0.13	0.12
y	C05 → C04	0.09	6.9	5.5	0.048	0.0168

$0 < T_{cy} < T_{cz} \rightarrow 0 < 6.9 < 13.5$

$$Q_{Ty} = Q_y + \frac{T_y}{T_z} Q_z = 0.09 + \frac{6.9}{13.5}(0.47) = 0.33 \text{ cfs}$$

$$Q_{Tz} = Q_z + \frac{I_z}{I_y} Q_y = 0.47 + \frac{3.9}{5.5}(0.09) = \underline{\underline{0.53}} \text{ cfs}$$

Junction @ C04:

$Q_{C04} = 0.53$ cfs

$T_c = 13.5$ min

$I = 3.9$ in/hr

ECA = 0.14

$A_{rea\ total} = 0.03 + 0.13 + 0.05 = 0.21$ ac

5. Node C04 → C06 (street flow)

C = 0.82
A = 0.17ac
CA = 0.14
ΣCA = 0.14 + 0.14 = 0.28

L = 190'
S = 0.041
n = 0.013

Assume q_{ave} = 3.0 cfs/ac , V = 3.0 ft/s

$Q_{ave} = 0.50 + (3.0)(0.17)/2 = 0.76$ cfs ←

$T_t = \frac{L/V}{60} = \frac{190/3}{60} = 1.1$ min

$T_c = 13.5$ min + 1.1 min
$= 14.6$ min

$I = 3.6$ in/hr

$Q_{C04 \to C06} = \Sigma CA\, I = (0.28)(3.6) = \underline{1.01}$ cfs

↳ Check

$Q_{ave} = 0.50 + (1.01 - 0.5)/2 = 0.76$ cfs ← ✓ ok

$Q_{C06} = 1.01$ cfs	$\Sigma CA = 0.28$
$T_c = 14.6$ min	
$I = 3.6$ in/hr	

POST 100-9/10

System D

1. Node D01 → D02 (natural landscape)

$C = 0.35$ $\quad L = 290'$ $\quad T_C = 8.7$ min

$A = 0.48$ ac $\quad S = 0.037$

$\Sigma CA = 0.168$ $\quad L_m = 100'$ $\quad I = 5.0$ in/hr

$$Q_{D01 \to D02} = \Sigma CA\, I = (0.168)(5) = 0.84 \text{ cfs}$$

$Q_{D02} = 0.84$ $\quad \Sigma CA = 0.168$

$T_C = 8.7$ min

$I = 5.0$ in/hr

Post 100-10/10

2. Outlet 2 - Junction of C06 & D02 @ SD on Via Rosa

	System	Q (cfs)	Tc (min)	I (in/hr)	A (ac)	ΣCA
→ Z	C	1.01	14.6	3.6	0.38	0.28
Y	D	0.84	8.7	5.0	0.48	0.168

$0 < T_{cy} < T_{cz} \rightarrow 0 < 8.7 < 14.6$

$$Q_{Ty} = Q_y + \frac{T_y}{T_z} Q_z = 0.84 + \frac{8.7}{14.6}(1.01) = 1.44 \text{ cfs}$$

$$Q_{Tz} = Q_z + \frac{I_z}{I_y} Q_y = 1.01 + \frac{3.6}{5.0}(0.84) = \underline{1.61} \text{ cfs}$$

$Q_{outlet2} = 1.61$ cfs

$T_c = 14.6$ min

$I = 3.6$ in/hr

$A = 0.86$ ac

100-year post Development